Active Project (2016 - 2016)

Flow Control on a High Lift Airfoil Using High-Bandwidth Microactuators, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

High-lift airfoils employ trailing edge flaps during takeoff and landing and are stowed during the cruise. These airfoils enhance the lift characteristics at subsonic speeds but suffer due to flow separation over the deflected flap surface. During cruise at transonic speeds, the shock induced separation results in drag penalty and structural fatigue. Traditionally, high-lift airfoils employ multi-element flaps to eliminate flow separation during takeoff and landing but at the cost of increased mechanical complexity and aircraft weight. Active flow control (AFC) has the potential to mitigate flow separation and enhance performance. The objective of proposed study is to design, develop, validate and implement a closed-loop, high-bandwidth active flow control technique. The technique will be based on high-momentum, resonance-enhanced unsteady microjet actuators and implemented on an NASA-EET high-lift airfoil configuration. Under the proposed program we bring a team of experts with the requisite knowledge and tools needed for successful development and implementation. We will deign and build a high-lift airfoil to suit the FSU polysonic wind tunnel for testing at high subsonic and transonic speeds (Mach 0.3 - 0.9). We will implement and demonstrate the applicability of Adaptive Sampling-Based Model Predictive Control (SBMPC) to control flow separation.

ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: The proposed development of a closed-loop, high-bandwidth active flow control technique using high-momentum, resonance-enhanced unsteady microactuators will help achieve NASA?s objective to build an energy efficient and environment-friendly fixed-wing transport aircraft. The proposed AFC method is an on-demand, and closed-loop technique is capable of improving vehicle performance and adaptive to the flight changes. The actuators

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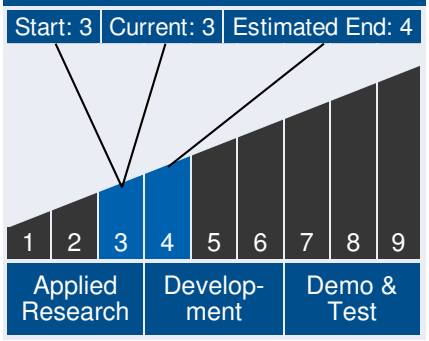
Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

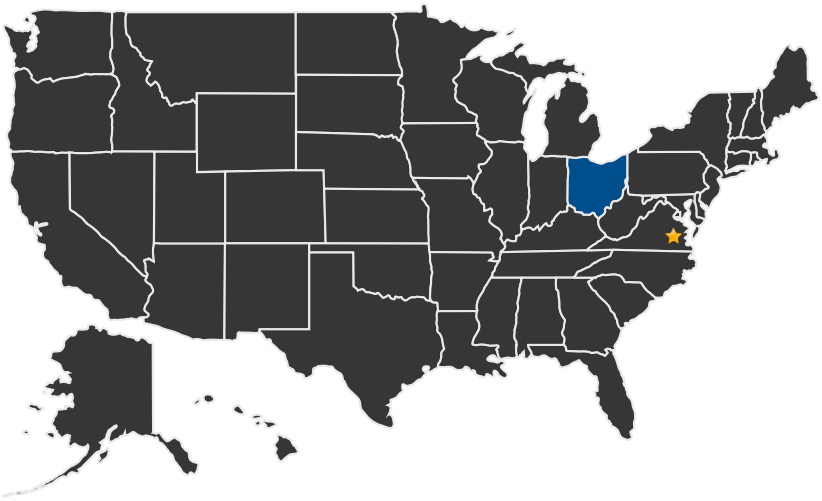
Continued on following page.

proposed are simple, energy-efficient, high-bandwidth, reliable and robust. The proposed technology will support NASA N+2 and N+3 performance goals.

To the commercial space industry:

Potential Non-NASA Commercial Applications: In addition to aeronautical industry, the development of unsteady actuation will be very useful to automotive industry in reducing aerodynamic drag and improving energy efficiency. The proposed team is in the process of establishing an Industry & University Cooperative Research Center (I/UCRC) in the broad area of Applications of Flow Control with the help of National Science Foundation (NSF). This will help us leverage our collaboration with broader aerospace and automotive community.

U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

Lead Center:
Langley Research Center

Other Organizations Performing Work:

- Spectral Energies, LLC (Dayton, OH)

Management Team *(cont.)*

Principal Investigator:

- Sivaram Gogineni

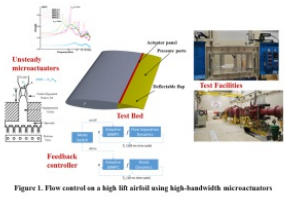
Flow Control on a High Lift Airfoil Using High-Bandwidth Microactuators, Phase I Project

PROJECT LIBRARY

Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/23174)

IMAGE GALLERY



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DETAILS FOR TECHNOLOGY 1

Technology Title

Flow Control on a High Lift Airfoil Using High-Bandwidth Microactuators, Phase I

Potential Applications

The proposed development of a closed-loop, high-bandwidth active flow control technique using high-momentum, resonance-enhanced unsteady microactuators will help achieve NASA?s objective to build an energy efficient and environment-friendly fixed-wing transport aircraft. The proposed AFC method is an on-demand, and closed-loop technique is capable of improving vehicle performance and adaptive to the flight changes. The actuators proposed are simple, energy-efficient, high-bandwidth, reliable and robust. The proposed technology will support NASA N+2 and N+3 performance goals.